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Dated 27 March 2002

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1/77

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P01/7700 0.00-0103959.3

THE PATENT OFFICE
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17 FEB 2001
NEWPORT

Request for grant of a patent

The Patent Office

Cardiff Road
Newport
South Wales NP10 8QQ

1.	Your reference	A10260GB - WL/djr
2.	Patent application number *(The Patent Office will fill in this part)*	**0103959.3** 17 FEB 2001
3.	Full name, address and postcode of the or of each applicant *(underline all surnames)*	Cincinnati Machine UK Limited PO Box 505 Kingsbury Road Birmingham B24 0QU
	Patents ADP number *(if you know it)*	
	If the applicant is a corporate body, give the country/state of its incorporation	UNITED KINGDOM 8084733001
4.	Title of the invention	Machine Tools
5.	Name of your agent *(if you have one)*	Forrester Ketley & Co.
	"Address for service" in the United Kingdom to which all correspondence should be sent *(including the postcode)*	Chamberlain House Paradise Place Birmingham, B3 3HP.
	Patents ADP number *(if you know it)*	133005

6.	If you are declaring priority from one or more earlier patent applications, give the country and the date of filing of the or each of these earlier applications and *(if you know it)* the or each application number	Country	Priority application number *(if you know it)*	Date of filing *(day/month/year)*

7.	If this application is divided or otherwise derived from an earlier UK application, give the number and the filing date of the earlier application	Number of earlier application	Date of filing *(day/month/year)*

8.	Is a statement of inventorship and of right to grant of a patent required in support of this request? *(Answer "Yes" if:* *a) any applicant named in part 3 is not an inventor, or* *b) there is an inventor who is not named as an applicant, or* *c) any named applicant is a corporate body.* *See note (d))*	YES

9. Enter the number of sheets for any of the following items you are filing with this form. Do not count copies of the same document.

Continuation sheets of this form	-
Description	8
Claim(s)	4
Abstract	-
Drawing(s)	3 + 3

10. If you are also filing any of the following, state how many against each item.

Priority documents	NONE
Translation of priority documents	-
Statement of inventorship and right to grant of a patent *(Patents Form 7/77)*	-
Request for preliminary examination and search *(Patents Form 9/77)*	-
Request for substantive examination *(Patents Form 10/77)*	-
Any other documents *(please specify)*	-

11. I/We request the grant of a patent based on the basis of this application

Signature Forrester Ketley & Co

Date 16 February, 2001

Forrester Ketley & Co.

12. Name and daytime telephone number of person to contact in the United Kingdom: William Lally 0121 236 0484

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Notes

a) *if you need help to fill in this form or you have any questions, please contact the Patent Office on 0645 500505.*

b) *Write your answers in capital letters using black ink or you may type them.*

c) *If there is not enough space for all the relevant details on any part of this form, please continue on a separate sheet of paper and write "see continuation sheet" in the relevant part(s). Any continuation sheet should be attached to this form.*

d) *If you have answered "Yes" Patents Form 7/77 will need to be filed.*

e) *Once you have filled in the form you must remember to sign and date it.*

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PATENTS ACT 1977

A10260GB - WL/djr

Title: Machine Tools

Description of Invention

This invention is concerned with improvements relating to machine tools, particularly machine tools during use of which large quantities of cut material (conventionally termed "swarf") are produced. The invention has been devised in relation to a vertical cutting machine, particularly for the production of a machined metal part, in which context the invention will hereinafter be described. It is however to be understood that the invention is not limited to this specific context, and may be utilised generally, eg. in milling, drilling, reaming, grinding machines, or in machines designed to operate on non-metallic material, eg. in the production of plastic workpieces.

In the production of a machined part a cutting tool, conventionally rotated at high speed, is traversed across a workpiece secured to a machine table mounted for movement above a machine bed, the cutting tool removing metal from the workpiece in stages, the removed metal constituting scrap or swarf. To ensure high quality cutting action, a cutting fluid is conventionally directed to the interface between the cutting tool and the workpiece, providing lubrication for the cutting action, washing cut material from the immediate vicinity of the interface, and to maintain the temperature of the cutting tool at a preferable low temperature.

Cut material falls away from the workpiece onto surfaces of the machine, such as the machine bed or floor, or the machine cover for the internal machinery of the machine, and particularly for workpieces of aluminium and similar materials having a high cut rate, the build up of swarf can be considerable. For this purpose it is conventional to provide in a machine tool a swarf management system, to remove the swarf from the machine bed, and other surfaces upon which the material may accumulate. The management

system may comprise removal means in the form of scraper bars which move across the surface to scrape the material onto a conveyor belt, or means to produce liquid flow streams to wash the material onto the conveyor belt, or both. Where wash bars are utilised, it is difficult to locate these without interference with the normal operational movement of the machine parts, and they may easily be knocked out of position in use.

Where a fluid flow stream is utilised it is necessary to utilise the same fluid as is used as the cutting fluid, since inevitably the two streams will become inter-mixed.

Clearly, theoretically, no problem needs to be encountered in maximising the flow of cleaning fluid to ensure a complete removal of swarf from machine surfaces, enabling the scrap material conveniently to be conveyed away from the immediate vicinity of the machine, and for the cutting and cleaning fluids to be separated from the scrap and returned conveniently to a storage tank. However, a large flow rate of cleaning fluid suffers from a number of disadvantages, including the following:

a) the need to retain large volumes of fluid in a tank;

b) the need to provide a large filtering capacity, to filter out scrap material;

c) the need to utilise large pumps to provide a satisfactory flow of the cleaning fluid over the machine surfaces;

d) the loss of water from the cleaning fluid through evaporation;

e) the contamination of the atmosphere with evaporate.

Additionally, currently cutting fluids may comprise oxidation inhibitors, bacteriological inhibitors, lubricants etc., and are thus not inexpensive, and there are thus further disadvantages in utilising high flow rates of liquid for the removal of the scrap.

According to this invention there is provided a method of cleaning cut material from a machine tool, in which a cleaning fluid is flowed across surfaces of the machine intermittently.

In this manner the cleaning fluid may be flowed at a higher volume than would otherwise be desirable or practical. Thus, a higher flow rate may be utilised periodically to wash larger volumes of swarf from the machine surfaces.

In this manner not only may swarf more easily be removed by the high volume flow, but also the overall flow rate of the cleaning fluid through the system may be reduced.

Preferably, a continuous flow of cleaning fluid is utilised in the method, the cleaning fluid flowing into a receptacle from which fluid flows periodically in a cleaning operation.

Thus, preferably means is utilised to restrain significant flow of fluid from the receptacle until a substantial volume has accumulated within the receptacle.

Preferably the intermittent flow from the receptacle may be achieved by the use of valve mechanism, eg. periodic-operating valve mechanism, but preferably is achieved by the use of syphon.

Preferably and to obviate the use of moving parts, a double syphon is utilised, enabling outflow through a large diameter pipe to be achieved with a relatively slow in-feed rate.

Preferably the quantity which is flowed intermittently is between three and ten litres, conveniently between five and seven litres, and is conveniently outflowed over a period of five seconds or less.

Preferably the time interval between successive outflows is between thirty seconds and two minutes, conveniently an outflow occurring every minute or thereabouts.

Conveniently such outflows are provided at various parts of the machine, to ensure swarf is washed from all appropriate or desirable surfaces, and in a typical machine four such outflows may be utilised.

According to this invention there is also provided a machine tool comprising means to flow fluid across one or more surfaces of the machine to remove swarf, said means comprising:

a) a fluid receptacle;

b) means to deliver fluid to the receptacle at a generally constant flow rate;

c) an outflow line extending from the receptacle to one or more machine surfaces through which fluid may flow from the receptacle in the removal of swarf from the surface; and

d) means to cause fluid to flow from the receptacle only intermittently.

Preferably the delivery means comprises a pump operative to pump fluid to the receptacle at a flow rate of between 2 and 10 litres per minute, conveniently between 5 and 7 litres per minute, and the receptacle comprises means to cause fluid to be delivered therefrom intermittently at a higher rate than the delivery of fluid thereto. Conveniently said means is operative to discharge the receptacle in a period of time conveniently of 2.5 and 7 seconds, conveniently about 3 to 5 seconds, and conveniently the volume of fluid discharged is substantially the whole contents of the receptacle.

Preferably the machine comprises a plurality of such fluid receptacles, such delivery means, such outflow and such means to cause liquid to flow from the receptacle, operative to cause fluid to flow across a plurality of surfaces of the machine to remove swarf.

Preferably the machine comprises sump means, into which cutting fluid and swarf are flowed, and within which the fluid and swarf are separated.

Conveniently located in the sump means is a pump operative to deliver fluid from the sump to the or each receptacle at a substantially constant flow rate.

Preferably such pump means is also operative to delivery fluid to the cutting head of the machine.

There will now be given a detailed description to be read with reference to the accompanying drawings, of a machine which is a preferred embodiment of this invention, having being selected for the purposes of illustrating the invention by way of example, the machine comprising a swarf management system which is also illustrative of the invention in certain of its aspects.

In the accompany drawings:

FIGURE 1 is a schematic perspective view of the preferred embodiment;

FIGURE 2 is an exploded perspective view of part of the machine, showing a sump thereof; and

FIGURE 3 shows schematically the means to cause fluid to be delivered from a receptacle of the machine only intermittently.

The machine which is the preferred embodiment of this invention is a machine tool of conventional type, which will be described hereinafter only in general terms insofar as it is necessary to understand the present invention. The machine comprises a floor plate 6 above which a machine bed 8 is mounted, and mounted for movement across the machine bed is a machine table 10, to which a workpiece (not shown) may be secured in conventional manner. Extending upwardly from the machine bed is a spindle carrier 12, comprising guide-ways 14 on which a machine head (not shown) may be mounted for movement towards and away from the machine table.

The construction and arrangement will conventionally be such as to permit relative movement to take place between a tool carried by the tool head and a workpiece mounted on the machine table in at least three orthogonal axes, to permit the production of a machine part to a desired design, from a

workpiece, the moving parts of the machine being enclosed within a plastic or metal cover 36, shown in dotted lines in figure 1.

Mounted on the floor plate 6 is a cover 7, within which internal machinery for the machine is located, including for example the machine motor, ball screw drives, and control devices.

In the use of the machine in performing a cutting operation on a workpiece, cut material, typically known as and referred to hereinafter as swarf, will fall onto the machine table, onto the cover, onto the floorplate, and onto other surfaces of the machine, and it is necessary for this material to be removed. For this purpose on either side of the machine is a housing 18, into the interior of which swarf may be caused to move, either by the use of cleaning fluid in conventional manner, or by the use of scraper bars, or by hand.

Thus, each housing 18 provides a sump chamber 19 (see figure 2), into which cutting liquid and cut material may pass conveniently through an opening 20. Located within the sump chamber is a conveyor 22, conveniently a scraper conveyor, operative to transfer solid material from the sump chamber and through an upwardly inclined section 30, to a discharge point 32, from which cut material may be deposited into a container, for accumulation and subsequent removal. During passage of the solid material from the sump chamber, particularly during passage through the included section 30, cutting fluid flows backwardly into the sump chamber.

Located in a sump chamber is a pump chamber 24, into which fluid flows from the sump chamber, through a filter material, and from which fluid is flowed by the use of a pump 26, as will hereinafter be described.

Liquid which accumulates in the left hand sump chamber 18a is delivered to the right hand sump chamber 18b by a flow pipe, allowing a single pump 26 to be utilised in the operation of the machine. Thus, conveniently the pump operates, in the preferred embodiment, at a flow rate of 25 litres per minute, 5 litres per minute for each of the receptacles 40, and 5 litres per

minute being directed to the cutting head of the machine, for lubrication of the cutting tool during operation. However, as will self-evidently be appreciated, two pumps of smaller capacity may be utilised, one operative within each of the two sump chambers.

Located at any convenient position on the machine, typically at the four locations shown in figure 1 of the drawings, is a fluid discharge receptacle 40, to which fluid is delivered from the pump 26, and from which fluid flows through an outlet duct 48 directed towards those surfaces of the machine where it is desired to remove accumulated swarf.

The receptacle 40 is in the form of a double-syphon, comprising a first-stage syphon 44 and a second-stage syphon 46 (see figure 3a). Typically fluid is delivered to the first-stage syphon through a pipe 42, of narrow bore, conveniently provided by hose having diameter of ½" (12.5mm), through which fluid is flowed from pump 26 at a rate of 5 litres per minute. The capacity of the first-stage syphon 44 is typically 2 litres, and thus after 24 seconds or so the first-stage syphon is filled, and liquid is discharged therefrom through the outlet 45 of the first-stage syphon, into the second-stage syphon, conveniently utilising a hose of larger diameter than the inlet 42, typically of 1" diameter (25mm), (see figure 3b).

The capacity of the second-stage syphon 46 typically 5 litres, and thus after the dispensing into the second stage syphon 46 of (typically) 3 outflows from the first-stage syphon, the second-stage syphon 46 is filled, and liquid is outflowed therefrom through the hose 48, which may be of larger diameter, conveniently 1½" (38mm), (see figure 3d). This enables substantially the entire contents of the second-stage syphon 46 to be dispensed through the outlet 42 within 2 or 3 seconds, producing a high flow rate across the surfaces of the machine, and ensuring a thorough removal of accumulated swarf, to flow onto the floorplate, and through the openings 20 into the sump chambers 19.

Whilst in the preferred embodiment the intermittent flow rate is achieved by the use of one, preferably two, syphons, other means may be utilised to put the invention into practice if desired.

For example, the receptacle to which fluid is delivered may be provided with valve mechanism, conveniently time-operated, which may be caused to open at pre-determined periods, to cause the contents of the receptacle to be discharged in a short period of time, to produce the desired "flushing" action.

As will be seen from figure 1, the machine comprises four such receptacles, to each of which liquid is delivered from the pump 26 at the low flow rate of (typically) 5 litres per minute, each of the receptacles 40 producing a high intermittent flow of liquid to wash the surfaces of the machine clear of accumulated swarf.

In the present specification "comprise" means "includes or consists of" and "comprising" means "including or consisting of".

The features disclosed in the foregoing description, or the following claims, or the accompanying drawings, expressed in their specific forms or in terms of a means for performing the disclosed function, or a method or process for attaining the disclosed result, as appropriate, may, separately, or in any combination of such features, be utilised for realising the invention in diverse forms thereof.

CLAIMS

1. A method of cleaning cut material from a machine tool, in which a cleaning fluid is flowed across surfaces of the machine tool intermittently.

2. A method according to claim 1 wherein a continuous flow of cleaning fluid is utilised, the cleaning fluid flowing into a receptacle from which fluid flows periodically in a cleaning operation.

3. A method according to claim 2 wherein means is provided to restrain significant flow of fluid from the receptacle until a substantial volume has accumulated within the receptacle.

4. A method according to claim 3 wherein the substantial volume is at least 2 litres, and is preferably 5 litres or more.

5. A method according to any one of the preceding claims wherein the intermittent flow is achieved by the use of valve mechanism.

6. A method according to claim 5 wherein the valve mechanism is period-operating valve mechanism.

7. A method according to claim 5 wherein the valve mechanism comprises a syphon.

8. A method according to any one of the preceding claims wherein the intermittent flow is achieved by the use of a double syphon.

9. A method according to claim 8 wherein the quantity which is flowed intermittently is between 3 and 20 litres.

10. A method according to claim 9 wherein the quantity is between 5 and 10 litres.

11. A method according to any one of the preceding claims wherein the time interval between successive outflows is between 30 seconds and 2 minutes.

12. A method according to any one of the preceding claims wherein a plurality of such outflows are provided.

13. A machine tool comprising means to flow fluid across one or more surfaces of the machine to remove swarf, said means comprising:

a) a fluid receptacle;

b) means to deliver fluid to the receptacle at a generally constant flow rate;

c) an outflow line extending from the receptacle to one or more machine surfaces through which fluid may flow from the receptacle in the removal of swarf from the surface; and

d) means to cause fluid to flow from the receptacle only intermittently.

14. A machine tool according to claim 13 wherein the delivery means comprises a pump operative to pump fluid to the receptacle at a flow rate of between 2.5 and 10 litres per minute.

15. A machine tool according to claim 14 wherein said flow rate is between 5 and 7 litres per minute.

16. A machine tool according to one of claims 14 and 15 wherein the receptacle comprises means to cause fluid to be delivered therefrom intermittently at a higher rate than the delivery of fluid thereto.

17. A machine tool according to any one of claims 13 to 16 wherein said means is operative to discharge the receptacle in a period of time between 2 and 7 seconds.

18. A machine tool according to claim 17 wherein said period of time is between 3 and 5 seconds.

19. A machine tool according to any one of claims 13 to 17 wherein the volume of fluid discharged is substantially the whole of the contents of the receptacle.

20. A machine tool according to any one of claims 13 to 19 comprising a plurality of such fluid receptacles, said delivery means, said outflow and said means to cause liquid to flow from the receptacle being operative to cause fluid to flow across a plurality of surfaces of the machine.

21. A machine tool according to claim 20 comprising sump means into which cutting fluid and swarf are flowed, and within which the fluid and swarf are separated.

22. A machine tool according to claim 21 comprising a pump located in the sump and which is operative to deliver fluid to the or each receptacle at a substantially constant flow rate.

23. A machine tool according to claim 21 wherein the pump means is operative to deliver fluid to the cutting head of the machine.

24. A method of cleaning cut material from a machine tool, when carried out substantially as hereinbefore described with reference to the accompanying drawings.

25. A machine tool constructed and arranged substantially as hereinbefore described with reference to the accompany drawings.

25. Any novel feature or novel combination of features hereinbefore described and/or shown in the accompanying drawings.

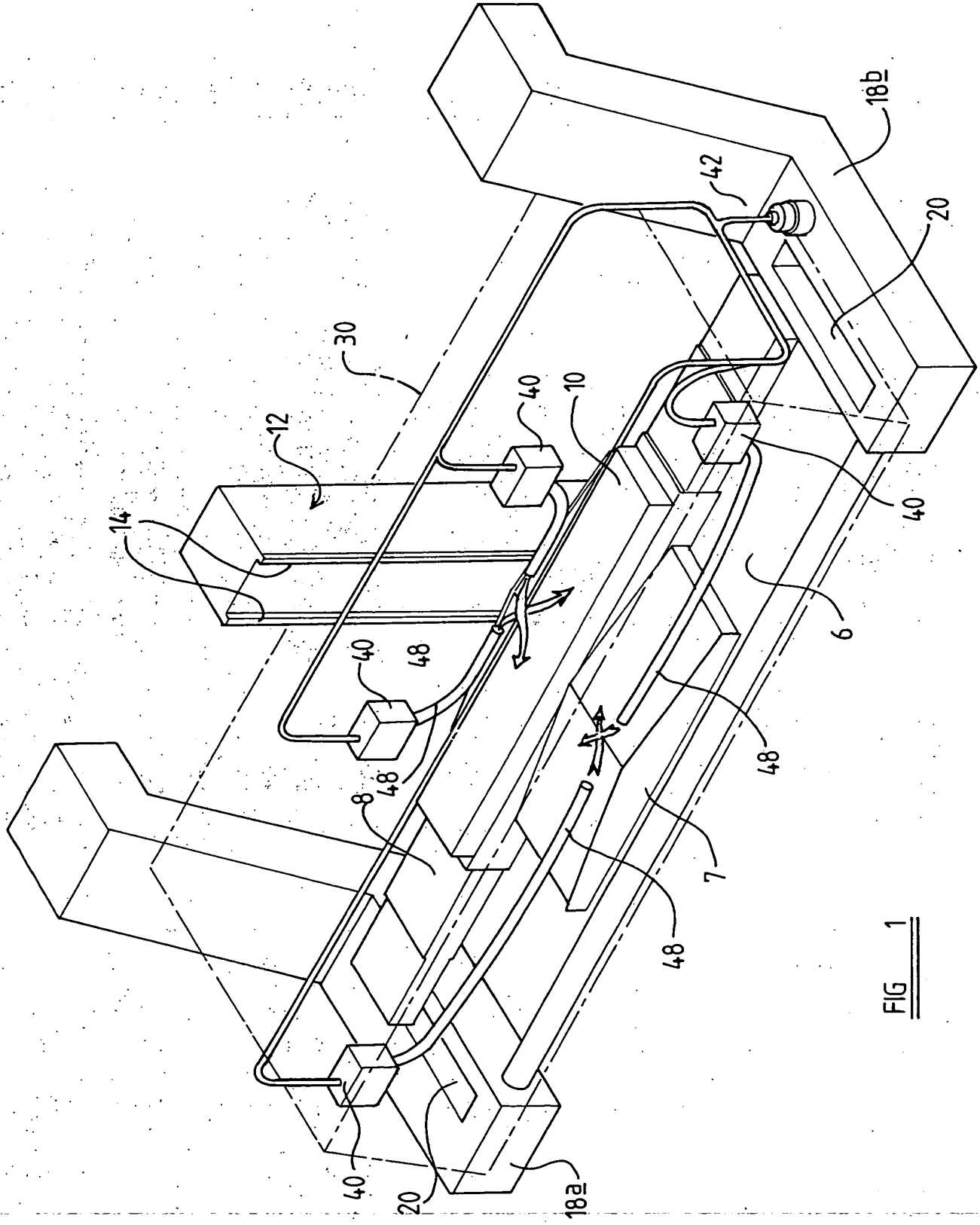

FIG 1

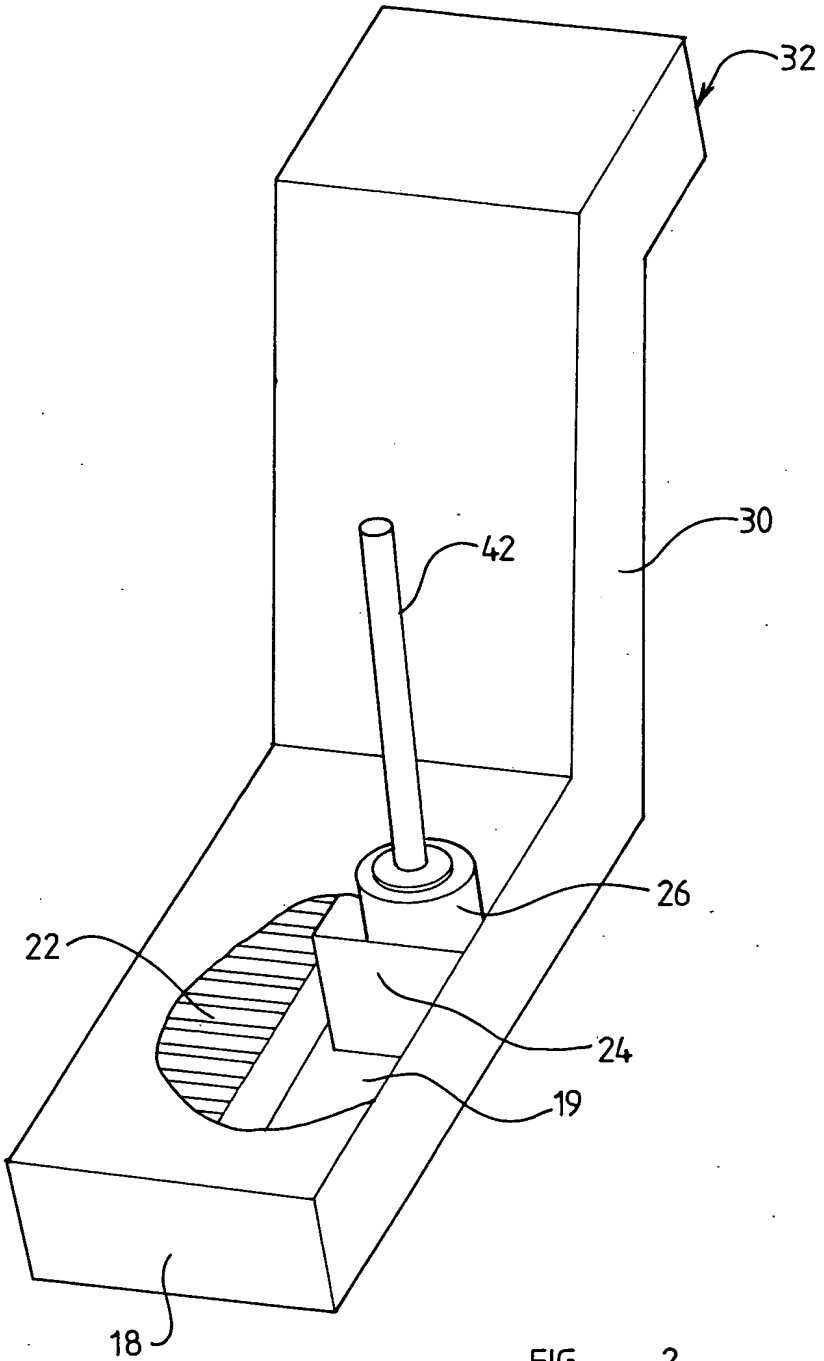

FIG 2

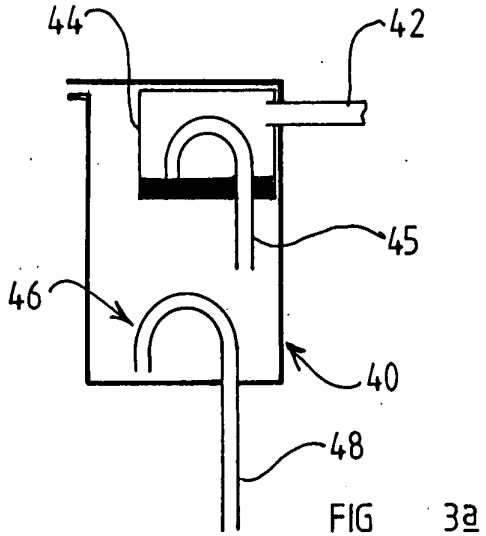

FIG 3a

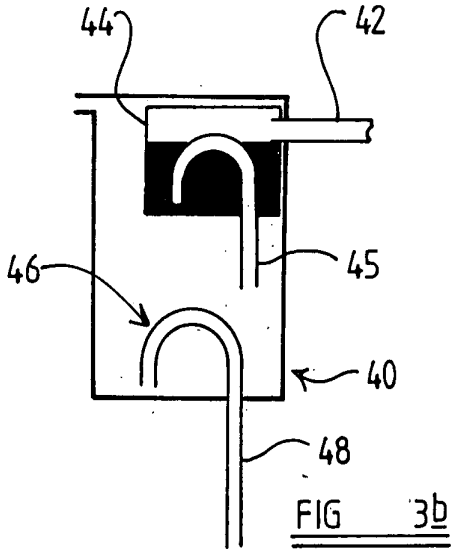

FIG 3b

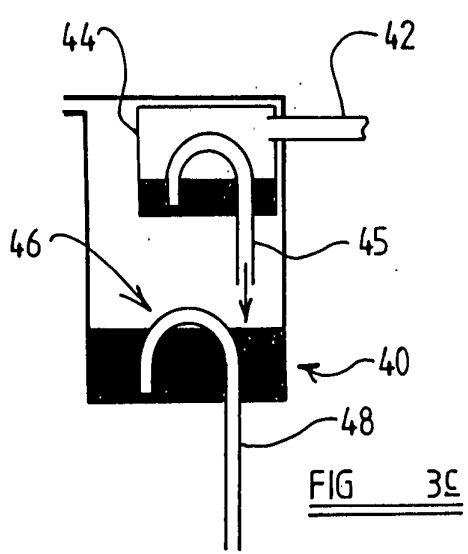

FIG 3c

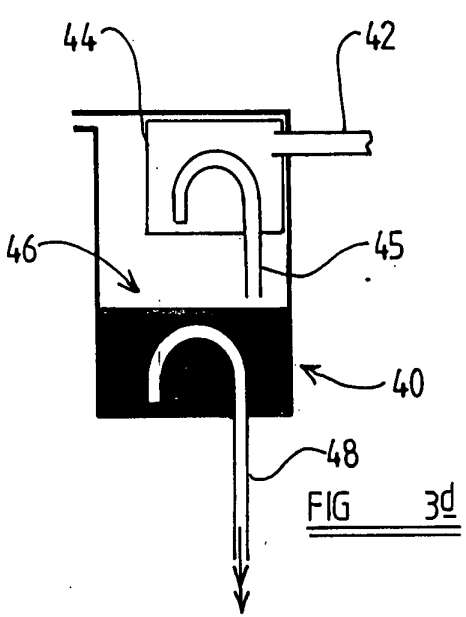

FIG 3d